

A LINIAR MODEL OF ANALYZING INFLATION IN ROMANIA, BULGARIA, TURKEY AND CROATIA

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The study uses a linear model that reviews the connection between inflation rate and a few macroeconomic indicators: Harmonized Index of Consumer Prices (HICP), Gross Domestic Product (GDP) and unemployment (Unempl). The purpose of this study is to discover the influence of these macroeconomic indicators on the inflation rate, taking into consideration a period of ten years: 2000-2010. The analysis approaches this issue from the perspective of two EU member countries: Bulgaria, Romania, and another two countries - EU candidates: Turkey and Croatia.

Although the tradeoff between inflation and unemployment has been long discussed, starting with the famous idea of the Phillips curve that has evolved during time (M.Friedman, E.Phelps), economists are still studying this theme in order to find satisfactory explanation for it. In this paper we have tried to find out whether, in the analyzed countries, there is a strong tradeoff between inflation and unemployment, but we also added other variables that influence inflation: the gross domestic product and the previous values of inflation.

Our paper started with a study of the economic background of each analyzed country then, we have collected quarterly data from the period of 2000-2010, that we processed using the econometric software Gretl. After building several models for each country we concluded that inflation in Romania and Croatia are influenced by the following variables: GDP and previous HICP, while the values of inflation in the other two countries are affected by more diverse range of independent variables.

Keywords: Inflation, Harmonized Index of Consumer Prices, Gross Domestic Product, Unemployment, Monetary policy

JEL Classification: E24, E31, E52

1. Introduction

The inflation phenomenon

As a phenomenon, inflation appeared at the same time with the development of money in the market economy and has manifested during the centuries reaching historic highs in the Twentieth Century, in which national monetary systems have abandoned the gold standard due to the economic, political and social crises. Many specialists (economists and not only) have tried to define the phenomenon, to explain its causes and the impact that it has on the standard of living. Mishkin F. (2004:10) defines inflation as a *continual increase in the price level* that affects individuals, businesses and the government. In recent years it has taken the place of one of the most important concern of the politicians and policymakers, many Central Banks have chosen the

mandate of achieving and maintaining price stability, which in turn provides an economic environment that is conducive to growth in savings and investment.

Overview of the macroeconomic background of Romania

Considering the fact that Romania has fought three digits inflation during the transition period from a centralised economy to a market one, it took almost a decade to get one digit inflation and obtain a sustainable decrease of the level of inflation rate. As stated by the Governor of Romanian National Bank, Mugur Isărescu (2008:20) between the years 2000-2007 Romania has managed to obtain an annual average 5,8 % disinflation rate in parallel with the maintaining of the financial stability through appropriate mix of economic policies.

Romania is one of the many developing countries that has adopted inflation targeting. The successful transition to the new monetary regime, made in 2005, was due to the independence of the central bank which has the sole goal of achieving and maintaining price stability.

Overview of the macroeconomic background of Turkey

Turkey is a developing country, that has joined the European Community (EC) as an associate member in 1963 on the signing of the Ankara Agreement, and in 1999 it gains the status of candidate member during the European Council of Helsinki.

Starting with December 1999 Turkey committed to program with the International Monetary Fund that sets the economic policy agenda; it consisted of two pillars that oblige the Turkish government to maintain dual targets (Telli, Voyvoda and Yeldan, 2009:203): a primary surplus target in fiscal balances and price stability via inflation targeting. This program was thought for the reason of enhancing the country's credibility, eventually leading to reductions in the rate of interest that would stimulate private consumption and fixed investments. The Central Bank of Turkey was granted independence in 2001 having to follow disguised inflation targeting until conditions were ready for full targeting. Finally on January 2006 the Central Bank adopted full-fledged inflation targeting.

Overview of the macroeconomic background of Bulgaria

During 1996, Bulgaria faced with the economy collapse due to the Bulgarian Socialist Party's slow and mismanaged economic reforms and an unstable and decentralized banking system, which led to an inflation rate of 311% and the collapse of the lev. The economic situation started to change in the spring 1997, when the currency board regime was introduced. These brought growth and stability to the Bulgarian economy. The currency board contained inflationary pressures and the three-digit inflation in 1997 was cut to only 1% in 1998. Supported by a well functioning currency board and by sound income and fiscal policies, until mid 2007 the disinflation process progressed well, even in the presence of strong growth of domestic credit and of the accession related excise tax rate increases. Bulgaria's entry into the EU in January 2007 is having a significant impact on the macroeconomic situation.

Overview of the macroeconomic background of Croatia

While the political life was changing in the 90's, on the economic front, Croatia experimented macroeconomic instability, manifested through hyperinflation. At the end of 1993, Croatia introduced the Stabilization Program, based on a nominal exchange rate anchor, that has successfully achieved its main aim: in the last 13 years (from 1994 to 2006) Croatia has enjoyed a stable inflation rate (Vizek, Broz, 2007:8).

Having inflation 2% higher than majority of high income EU Countries, Croatia should be compared to newly members of EU such as Bulgaria and Romania, which both have a much higher inflation of 6%. Since the introduction of the Stabilization program in 1993, the Croatian

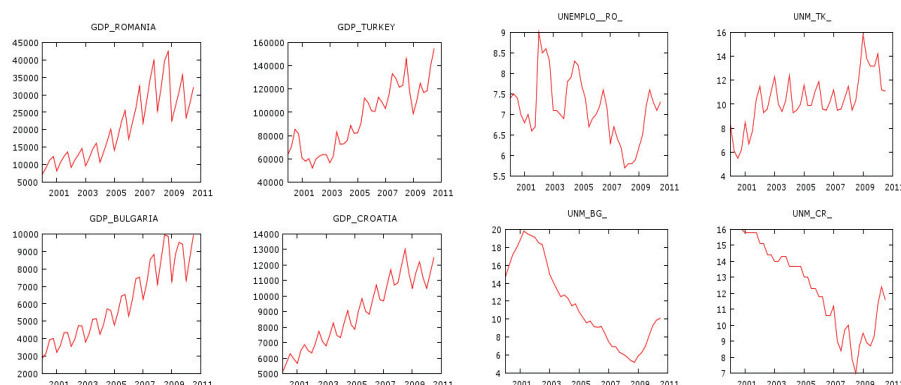
National Bank has been following the monetary strategy of exchange rate anchor. During the first several years (from 1993 to 1997) this monetary strategy achieved acceptable results, accompanied with a low inflation rate and high GDP growth rates.

2. Model

Data used and the methodology of research

Starting from the connection between the macroeconomic indicators: inflation rate, gross domestic product and unemployment rate, as shown in the economic reality, and after studying the national and international economic literature we gathered up the necessary data for a study case on Romania, Turkey, Bulgaria and Croatia in order to understand and verify the connection between the mentioned indicators.

We have collected quarterly data for the period of 2000-2010 using as sources: Eurostat (GDP and HICP, unemployment rate - Bulgaria and Romania), Turkstat (unemployment rate for Turkey) and the Institute of Economics Zagreb (unemployment rate for Croatia). In the research it has been used the open source software for econometric analysis Gretl.



Graphical analysis of time series GDP, HICP, unemployment

**Figure 1: Quarterly Gross Domestic Product
-millions of euro**

**Figure 2: Quarterly Harmonised Index
of Consumer Prices – percentage**

At the first view of Figure 1 it is noticeable that the basis trend line is ascending, even though during the analysed period the GDP has a fluctuating evolution, recording low values at the beginning of a year compared with the values recorded at the end of the year. Between the four analysed countries we notice that Turkey's GDP is highly over the other countries GDP's, meanwhile Bulgaria is situated at the opposite side-the lowest GDP. Until 2007 a slow growth rate of the GDP was recorded in all analysed countries, but since that point on the variation of the growth rate has substantially fluctuated. While the graphs for Romania, Bulgaria and Croatia show the seasonality of the GDP, the evolution of Turkey's GDP stands out because the seasonality is not so obvious.

The values of the Harmonised Indices of Consumer Prices between 2000 and 2010 (Figure 2) show a normal increasing evolution due to the rising prices of the goods and services in the economy, in all analysed countries. Turkey and Croatia has a smoother curve than the other two countries, indicating a continuous rise in prices without any significant decrease in prices level. On the other hand, Romania and Bulgaria experienced more sudden price change which made the curve of HICP to be more sinuous.

The country which registers the highest values of unemployment (Figure 3) rate is Bulgaria, followed by Croatia. However the unemployment rate has a sustained decrease since 2001 until 2009 in these countries. Although the other two countries Romania and Turkey registered relative

low unemployment rate, the evolution is highly fluctuating. In the case of Romania, the graphic presents dramatic changes of the unemployment rate from one year to another. Regarding Turkey, the changes are not so dramatic and seem to focus around the values of 10-12 percentages between 2002 and 2009. The effects of the economic crisis of 2008 on the labour market caused an increase of the unemployment rate from this date forward in all analysed countries.

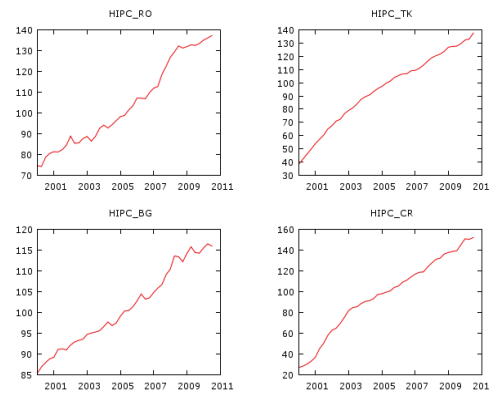


Figure 3: Quarterly unemployment rate-percentage

Adjusting the time series of GDP by removing its seasonality

Representation of data series in Fig. 1 shows that GDP has a strong seasonality, which will be removed using the X-12 ARIMA methodology¹⁹ used by the U. S. Bureau of Statistics; in order to make them stationary they need to be differentiated.

The econometric model

Through the development of this econometric model we aim to verify the possible correlation between inflation, gross domestic product and unemployment. We have chosen the following model:

$$y_{(t)} = a \cdot y_{(t-1)} + b \cdot \frac{1}{x'_{1(t)}} + c \cdot x_{2(t)} + \varepsilon_{(t)} \quad (1)$$

where:

- $y_{(t)}$ = Current HICP (quarter t)
- $y_{(t-1)}$ = Previous HICP (quarter t-1)
- $x_{1(t)}$ = Current unemployment rate (quarter t)
- $x_{2(t)}$ = Current GDP (quarter t)
- $\varepsilon_{(t)}$ = residual variable

Being a non linear model, it is liniairised through the introduction of the variable $x_{1(t)}=1/x'_{1(t)}$, leading to the following equation:

$$y_{(t)} = a \cdot y_{(t-1)} + b \cdot x_{1(t)} + c \cdot x_{2(t)} + \varepsilon_{(t)} \quad (2)$$

After eliminating the seasonality of the GDP using the X-12 ARIMA, we have looked up for its logarithm; we have also looked up for the logarithm of the previous HICP. Using the method of Ordinary Least Squares we have obtained the two models for each country.

Romania

¹⁹ For a broader discussion on the use of X-12 ARIMA: <http://www.census.gov/srd/www/x12a/>

In the case of Romania, current value of HICP is influenced by the values of GDP and the HICP values of the previous quarter. The constant and the unemployment rate are not representative -do not pass the student t-test, they are not relevant at the level of the population- in the first model, therefore we consider as a more relevant model, the second one.

The equations would be:

For the first model:

$$1) \text{ l_HICP} = 0.08391 * \text{const} + 0.06027 * \text{ l_GDP_d11} + 0.09335 * \text{inv_unempl} + 0.8535 * \text{ l_HICP_1}$$

For the second model:

$$2) \text{ l_HICP} = 0.06149 * \text{ l_GDP_d11} + 0.8719 * \text{ l_HICP_1}$$

The results of the model reveal that in the case of Romania the current HICP is directly influenced by the l_GDP and the previous l_HICP_1. The other two variables-constant and unemployment- are not representative for the evolution of current HICP.

The evolution of the current month inflation rate, shown by the HICP, is conditioned by the evolution of the HICP of the previous period (quarter) and by the evolution of the GDP.

Bulgaria

The results shown by the analysis of Bulgaria data using the model has revealed the HICP is influenced by the values of the constant, GDP and the HICP values of the previous quarter, and the values of (t-3) quarter. Due to the fact that the unemployment rate is not representative (does not pass the student t-test) in the first model we consider as a more relevant model, the second one.

The equations would be:

For the first model:

$$1) \text{ l_HICP} = 0.7404 * \text{const} + 0.09624 * \text{ l_GDP_d11} - 0.03088 * \text{inv_unempl} + 0.4448 * \text{ l_HICP_1} + 0.2163 * \text{ l_HICP_3}$$

For the second model:

$$2) \text{ l_HICP} = 0.7210 * \text{const} + 0.08656 * \text{ l_GDP_d11} + 0.4511 * \text{ l_HICP_1} + 0.2319 * \text{ l_HICP_3}$$

The results of the model reveal that in the case of Bulgaria the current HICP is directly influenced by the constant, l_GDP and the l_HICP_1 values of the previous quarter and l_HICP_3-the values of (t-3) quarter, therefore by the most diverse number of independent variables among the four analyzed countries.

Turkey

For Turkey, HICP is influenced by the values of GDP, the unemployment and the values of the previous quarter of HICP. We consider as a more relevant model the second one because the constant is not representative (does not pass the student t-test) in the first model.

The equations would be:

For the first model:

$$1) \text{ l_HICP} = 0.07963 * \text{const} + 0.04119 * \text{ l_GDP_d11} - 0.2778 * \text{inv_unempl} + 0.8906 * \text{ l_HICP_1}$$

For the second model

$$2) \text{ l_HICP} = 0.05178 * \text{ l_GDP_d11} - 0.3134 * \text{inv_unp} + 0.8822 * \text{ l_HICP_1}$$

From the results we can conclude that l_GDP and the l_HICP values of the previous quarter, influences directly the dependent variable: current l_HICP. The one variable that influences in an indirect way the HICP, is the unemployment rate.

Therefore after the analysis we consider that in the case of Turkey there is a significant connection between the HICP and the unemployment rate. This situation can be attributed to the fact that the unemployment rate has a highly fluctuating evolution from one year to another during the analyzed period.

Croatia

For Croatia, the first model shows that the only independent variable that is representative for the population is the previous value of HICP, therefore we generated a second model. This revealed that with the new calculated coefficients there is also a correlation between current HICP and I_GDP , besides the HICP values of previous quarter. The influence of unemployment in both models is indirect but not representative. The final model, which we consider the most relevant, because the variables are representative, shows the connection between current GDP and previous quarter HICP.

The equations are:

For the first model:

$$1) I_HICP = -0.3575 * \text{const} + 0.09323 * I_GDP_d11 - 0.4089 * \text{inv_unempl} + 0.9074 * I_HICP_1$$

For the second model:

$$2) I_HICP = 0.04429 * I_GDP_d11 - 0.1868 * \text{inv_unp} + 0.9227 * I_HICP_1$$

For the third model:

$$3) I_HICP = 0.04541 * I_GDP_d11 + 0.9168 * I_HICP_1$$

The data that we generated shows that Croatia has a similar situation to Romania's, meaning in both countries, the current value of the HICP is directly influenced by the values of the previous quarter HICP and the values of the current GDP, the other two independent variables not having a relevant influence on the dependent variable.

Conclusion

In this study we aimed to analyse the connection between inflation and some macroeconomic indicators in Romania, Bulgaria, Turkey and Croatia, therefore we first started with a short study of the economic background of each country in order to be able to build and explain the model. Following the analysis of the macroeconomic situation of each country mentioned above we conclude the following things:

Romania, which is now part of the European Union, has a short history of market economy-two decades-period in which the economy has struggled with high levels of inflation, public deficit, high rates of unemployment. Beginning with the year 2000 it was obvious a sustained economic growth which made possible the implementation of reforms.

The case of Turkey is not much different from the one of Romania, it struggled also with centralised economy, but the demographic aspects made the situation different. After some reforms the economy started to grow but in 2001 it is hit by a crisis. A special aspect of Turkey's economic policies is that during a few years it pursued two contradictory targets.

Another analysed country, Bulgaria, faced with the transition from the centralised economy to the market one had fought high economic imbalances during many years. After 1997 when it adopted a currency board regime, the economy began to stabilize. The 2000's saw a steady pace of growth and budget surpluses but shaky inflation.

With a dramatic history of the 1990's, Croatia begins to show stabilization in the macroeconomic situation until 2006, because of the introduction of the Stabilization Program. Since this year forward the macroeconomic indicators show a dramatic decrease also influenced by the 2008 crisis. From February 2005 Croatia is advancing to full EU membership.

Based on the analysis of the collected data and after processing them in order to eliminate the seasonality using X-12 ARIMA, and looking up for the logarithm for the GDP and HICP, we generated a series of equations from which we chose the most representative at the level of the population, after taking the student t-test. We generated two models for Romania, Turkey and Bulgaria and three for Croatia because we wanted to eliminate the non representative variables.

We observed that the only country in which unemployment has a relevant influence over the HICP is Turkey (and it is an indirect influence), meanwhile the previous values of HICP and

current values of GDP have a direct influence in all analysed countries over the studied period. Bulgaria's situation is a bit different from all the other analyzed countries: the value of current HICP is also influenced by the constant and by the values of (t-3) quarter HICP. Through this paper we tried a simplistic way of analyzing the influence of a few macroeconomic indicators over inflation; therefore this is a basic model that can be significantly improved through the introduction of more complex variables. The results, the similarities and differences between the countries, arise many questions that will be answered through a deeper research and improvement of the model.

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